

Appendix C.

UF Header Use in RADS

Additional parameters are required in RADS (Radar Acquisition and Display System) beyond what is presently provided for in the UF header. The purpose of this document is to precisely document the UF header *as used for Raw Data only*, and to indicate the use of the additional parameters required.

The UF format was originally defined for fields of data produced from a radar, such as reflectivity, power, velocity, etc. For raw data, the definition is stretched a little by calling all the data associated with a range gate a “field”. Some parameters, such as the noise power or the radar constant, used in calculating certain fields is subject to change and it is sometimes desirable to be able to recalculate the fields with different values of these parameters. Also, calculating and recording many different fields may reduce the maximum number of range gates possible.

The RADS RCP is driven by the Radar Parameters, which consists of 1000 bytes of information. Many parameters are in floating-point format, which is incompatible with the UF header that is built around 16-bit integers. The local use header, however, may contain any type of information and so the Radar Parameters, plus an additional 16-bit parameter placed in front of the Radar Parameters, are appended to the end of our present 60-word local use header. The purpose of the additional 16-bit parameter, which is the length of the Radar Parameters in bytes, is to align the Radar Parameters on a 32-bit boundary.

Floating-point data follow the parameter block, and its position is indicated by the appropriate word in the header. Because floating-point data are not supported by the UF format, we describe this format as an Extended UF format and place an “EF” at the beginning of the UF parameters, rather than a “UF.” This means that in order to be compatible with Perusal, data must be run through a “ef2uf” conversion program designed for RADS.

The following shows the UF-like header and format as it will be used on “raw” RADS tapes.

Table 1. RADS “Raw” Tape Format (EF Format)

Name	C structure	Length in 16-bit words	Position of first word
Mandatory_header	m_hdr	45	1
Optional_header	o_hdr	14	46
Wp6_local_header	l_hdr	61 + 500	60
Data_header	d_hdr	5	397
Field_header	f_hdr	25	402
Data	varies	varies	427

This gives a header length of 650 16-bit words. Programs should not rely on these lengths, however, but should instead use C header files and sizeof() operators. This will allow header sizes to change (in particular the local header or Radar Parameters) with a minimum amount of impact on the code.

Table 2. Mandatory Header

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from
1	1	EF	packet_type[2]	char[2]	2 ASCII	"EF"
2	2	Record length	record_length	u_short	16-bit words	format
3	3	Position of optional header	optional_hdr	u_short	16-bit words	format
4	4	Position of local header	local_h	u_short	16-bit words	format
5	5	Position of data header	data_hdr	u_short	16-bit words	format
6	6	Physical record number relative to beginning of file	physical_record_no	u_short	none	record
7	7	Volume scan number within tape	scan_volume_count	u_short	none	VLMN
8	8	Ray number within volume scan	ray_number	u_short	none	record
9	9	Physical record number within ray	physical_w_in_ray	u_short	none	1
10	10	Sweep number within this volume scan	sweep_count	u_short	none	scan
11-14	11-14	Radar Name	char_radar_[8]	char[8]	8 ASCII	RDNM
15-18	15-18	Site Name	char_site_[8]	char[8]	8 ASCII	STNM
19	19	Latitude, degrees	latitude_degrees	short	degrees	LAT
20	20	Latitude, minutes	latitude_minutes	short	minutes	LAT
21	21	Latitude, seconds	latitude_seconds	short	seconds * 64	LAT
22	22	Longitude, degrees	longitude_degrees	short	degrees	LONG
23	23	Longitude, minutes	longitude_minutes	short	minutes	LONG

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from
24	24	Longitude, seconds	longitude_seconds	short	seconds * 64	LONG
25	25	Elevation above sea level	altitude_above_sealevel	short	meters	ELSL
26	26	Year	Year	u_short	years (00-99)	TIME, TMOF
27	27	Month	Month	u_short	month	TIME, TMOF
28	28	Day	Day	u_short	day of month	TIME, TMOF
29	29	Hour	Hour	u_short	hours	TIME, TMOF
30	30	Minute	Minute	u_short	minutes	TIME, TMOF
31	31	Second	Second	u_short	seconds	TIME, TMOF
32	32	Time zone	time_zone[2]	char[2]	2 ASCII	TMZN
33	33	Azimuth angle	Azimuth	short	degrees * 64	AZIM
34	34	Elevation angle	Elevation	short	degrees * 64	ELEV
35	35	Sweep mode	sweep_mode	u_short	none	SWPM
36	36	Fixed angle	fixed_angle	short	degrees * 64	ANGF
37	37	Sweep rate	sweep_rate	u_short	deg/sec * 64	scan parameters
38	38	Generation date	generation_date_year	u_short	years (00-99)	raw-to-UF
39	39	Generation date	generation_date_month	u_short	month	raw-to-UF
40	40	Generation date	generation_date_day	u_short	day of month	raw-to-UF

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from
41-44	41-44	Tape generator facility name	word_41 - word_44	u_short	8 ASCII	raw-to-UF
45	45	Deleted or missing data flag	Missing	u_short	none	raw-to-UF

Table 3. Optional Header

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from
1-4	46-49	Project name	project_name[8]	char	8 ASCII	PRNM
5	50	Baseline azimuth	baseline_az	short	deg * 64	BLAZ
6	51	Baseline elevation	baseline_el	short	deg * 64	BLEL
7	52	Start of current volume scan	start_hour	u_short	Hours	TIME, TMOF
8	53	Start of current volume scan	start_minute	u_short	Minutes	TIME, TMOF
9	54	Start of current volume scan	start_second	u_short	Seconds	TIME, TMOF
10-13	55-58	Field tape name	field_tape_name[8]	char	8 ASCII	FTNM
14	59	Range gate flag	Flag	u_short	None	raw-to-UF

Table 4. WP6 Local Use Header

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from	Comment
1-4	60-63	Operator name	operator[8]	char[8]	8 ASCII	OPNM	
5	64	Radar x-coordinate w.r.t. origin	X	short	decameters	met params	future
6	65	Radar y-coordinate w.r.t. origin	Y	short	decameters	met params	future
7	66	Radar z-coordinate w.r.t. origin	Z	short	decameters	met params	future
8	67	Tape number	tape_no	u_short	None	TNUM	
9	68	Transmitter flag	trans_type	short	1 = magnetron -1 = klystron	TFLG	
10	69	Bandwidth of log receivers	log_bw	u_short	MHz	rgbw[0]	
11	70	Bandwidth of linear receivers	lin_bw	u_short	MHz	rnbw[0]	
12	71	RCP version #	rcp_ver	u_short	None	RCPN	
13-16	72-75	Scan name	scan_name[8]	char[8]	8 ASCII	met params	future
17	76	Scan center x-coordinate w.r.t. origin	scan_center_x	short	decameters	met params	future
18	77	Scan center y-coordinate w.r.t. origin	scan_center_y	short	decameters	met params	future
19	78	Scan radius w.r.t. origin	scan_radius	u_short	decameters	met params	future
20	79	Scan elevation, min, w.r.t. origin	Zmin	short	decameters	met params	future

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from	Comment
21	80	Scan elevation, max, w.r.t. origin	Zmax	short	decameters	met params	future
22	81	Total volume scan time	total_vtime	u_short	seconds * 10	scanning params	
23-25	82-84	Resolution: horizontal, vertical, time	resolution[3]	u_short	decameters decameters seconds*10	met params	future
26	85	Number of sweeps	num_sweeps	u_short	None	scanning params	
27	86	Sweep time	sweep_time	u_short	Seconds * 10	SWTM	
28	87	Azimuth boundary, CCW	az1	u_short	degrees * 64	MNAZ	
29	88	Azimuth boundary, CW	az2	u_short	degrees * 64	MXAZ	
30	89	Elevation or coplane boundary, lower	el1	u_short	degrees * 64	MNEL	
31	90	Elevation or coplane boundary, upper	el2	u_short	degrees * 64	MXEL	
32	91	Minimum R foreground	min_r_fg	u_short	decameters	met params	future
33	92	Maximum R foreground	max_r_fg	u_short	decameters	met params	future
34	93	Mininum R background	min_r_bg	u_short	decameters	met params	future
35	94	Maximum R background	max_r_bg	u_short	decameters	met params	future

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from	Comment
36-41	95-100	Elevation table for non-uniform elevation increments	el_table[6]	u_short	degrees * 64	met params	future
42	101	Number of radar triggers in sample	Ntrig	u_short	None	NTRG	
43	102	Long period, spacing between pairs	Lpd	u_short	μs * 4	PRPR	
44	103	Short period, spacing inside a pair	Spd	u_short	μs * 4	TRGS	
45	104	Number of triggers to wait between beams	Ntwt	u_short	None	NPWT	
46	105	Delay from trigger to first range gate	Dlay	u_short	μs * 4	DLAY	
47	106	Spacing between range gates in first group	Spac	u_short	μs * 4	SPAC	
48	107	Number of range gates in first group	nrg1	u_short	None	NRGT	
49	108	Spacing between range gates in second group	spc2	u_short	μs * 4	0	
50	109	Number of range gates in second group	nrg2	u_short	None	0	
51	110	Spacing between range gates in third group	spc3	u_short	μs * 4	0	
52	111	Number of range gates in all three groups	n_gates	u_short	None	NRGT	
53	112	Data acquisition mode or beam type	Mode	u_short	None	DMOD	
54	113	Polarization received	pol_received	u_short	None	RPL1, RPL2	
55	114	Nyquist velocity	Nyquist	u_short	m/s * 128	met params	future

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from	Comment
56	115	Maximum unambiguous range	max_unamb_range	u_short	km * 10	met params	future
57	116	Beam number of first beam of sweep	beam_no_of_1st_beam_of_sweep	u_short	None	record	
58	117	Number of transmit frequencies	Nfreq	u_short	None	NTFR	
59	118	Transmit frequency code	Xfreq	u_short	see following table	TFMD, TFST, NTFR	
60	119	Receiver pad code	rec_pad	u_short	see following table	RPDH, RPDV	
61	120	Length of Radar Parameters in bytes	rp_length_bytes	u_short	bytes	sizeof (Rp)	added for 32-bit alignment
62 - 338	121-396	Radar Parameters		structure			See Radar Parameters document

Table 5. Transmit Frequency Code -- Word 59 of Local Use Header

Bit	Function
0 (LSB)	=indicates uniform or Goloumb spacing mode
5-1	= transmitter frequency spacing in MHz for delta-k uniform spacing mode
10-6	= number of transmitter frequencies for delta-k mode (spacing as per bits 5-1 for uniform spacing) frequency spacing for Goloumb spacing mode: # freq spacing (units specified in bits 5-1) 1 0 2 1 3 2,1 4 2,3,1 5 2,5,3,1 6 2,5,6,3,1 7 2,5,8,6,3,1 8 7,3,6,2,12,1,4
15-11	Reserved

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Table 6. Receiver Pad Code -- Word 60 of Local Use Header

Bit	Function
5-0 (LSB)	= horizontal linear receiver pad in dB
11-6	= vertical linear receiver pad in dB
15-12	= reserved

Table 7. Data Header -- Applies to all data fields

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from	Comment
1	397	Total number of fields this ray	total_fields_this_ray	u_short	none, =0 if not field format	1	
2	398	Total number of records this ray	total_records_this_ray	u_short	none	1	
3	399	Total number of fields this record	total_fields_this_record	u_short	none	1	
4	400	Raw Data field name, "RD"	field_name[2]	char[2]	2 ASCII	DMOD	always "RD"
5	401	Position of 1st word of 1st field header	Fh	u_short	none	format	next word

Table 8. Field Header for Raw Data -- field headers precede each type of field data

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from	Comment
1	402	Position of first data word	data_position	u_short	16-bit words	format	
2	403	Scale factor (met units = tape value / scale factor)	scale_factor	u_short	varies	SCLF	0 for floating point
3	404	Range to first gate	range_to_first_gate	u_short	kilometers	DLAY, pknl[0]	
4	405	Adjustment to center of first gate	adjust_to_center	u_short	meters	DLAY, pknl[0]	
5	406	Sample volume spacing	sample_volume_spacing	u_short	meters	SPAC	
6	407	Number of sample volumes	num_sample_volumes	u_short	none	NRGT	
7	408	Sample volume depth	sample_volume_depth	u_short	meters	SPAC* NRGT	
8	409	Horizontal beam width	hor_bm_width	u_short	deg * 64	azbw	
9	410	Vertical beam width	ver_bm_width	u_short	deg * 64	elbw	
10	411	Receiver bandwidth	receiver_bandwidth	u_short	MHz	rnbw[0]	
11	412	Transmit/receive polarization code	polarization_transmitted	u_short	see next table	TPL1, TPL2	
12	413	Wavelength	Wavelength	u_short	cm * 64	TFRQ	
13	414	Number of samples used in field estimate	num_samples_in_field_estimate	u_short	none	NTRG	
14	415	Threshold field	threshold_field[2]	2 char	2 ASCII	raw-to-UF	
15	416	Threshold value	threshold_value	u_short	varies	raw-to-UF	
16	417	Scale (used for scaling dB's, following)	Scale	u_short	none	64	
17	418	Edit code	edit_code	u_short	2 ASCII	raw-to-UF	

Word index	Word index in UF	Contents	C Variable Name	Data type	Units	Derived from	Comment
18	419	Pulse repetition period	Prpr	u_short	microsecond s	TRGS	
19	420	Bits per sample volume	bits_per_sample_vol	u_short	none	BPDS	32-bit floating point
20	421	Radar constant $\text{dBZ} = (\text{RC}_A + \text{data})/\text{Scale} + 20 \log(\text{range in km})$ or $\text{dB} = (\text{RC}_O + \text{data})/\text{Scale} + 30 \log(\text{range in km})$	radar_constant	short	dB	kRC[0]	
21	422	Noise power	noise_power	short	dBm * scale	R0h[0] or R0v[0], RPL1, RPL2, rnbw[0]	
22	423	Receiver gain	receiver_gain	short	dB * scale	rnh[] or rnv[0], RPL1, RPL2	
23	424	Peak power	peak_power	short	dBm * scale	TPWR	
24	425	Antenna gain	antenna_gain	short	dB * scale	antg	
25	426	Pulse duration	pulse_duration	u_short	microsecond s * 64	RTLN	

Table 9. Transmit/Receive Polarization Code -- Word 11 of Field Header (not relevant for differential phase modes)

Bit	Function
0 (LSB)	Reserved
1	Reserved
3,2	00 = horizontal transmit polarization 01 = vertical transmit polarization 1x = pulse-to-pulse transmit polarization switching trigger 1 always vertical, trigger 2 always horizontal.
4	0 = horizontal linear receiver polarization 1 = vertical linear receiver polarization
6,5	00 = error 01 = .05us xmit pulse, 20 MHz lin BW, 20 MHz log BW 10 = .25us xmit pulse, 4 MHz lin BW, 4 MHz log BW 11 = 1.0us xmit pulse, 1 MHz lin BW, 4 MHz log BW
8,7	x0 = single transmit frequency 01 = delta-k mode, uniform frequency spacing 11 = delta-k mode, Golomb frequency sequence
15-8	Reserved

Table 10. Data -- Raw Data in all modes are 32-bit floating-point. Complex data are in **bold**. Quantities shown are repeated for each range gate

Mode name	Pulse Pair	Diff Phase, equally spaced	Diff Phase, high speed	Diff Phase, unequally spaced	Diff Phase, all fields
Mode number	140	150	151	158	159
Quantities recorded for each range gate	A, B, R, Lv, Lh	RsHH1, RsVV1, RIHH0, RIVV0, RsHV1, RsVH1, GIHh, GIhv, GIVh, GIVv	RsHV1, RsVH1, GIHh, GIhv, GIVh, GIVv	RsHH1, RsVV1, RIHH0, RIVV0, RIHV2, RIVH2, RIHH4, RIVV4, GIHh, GIhv, GIVh, GIVv	RsHH1, RsVV1, RIHH0, RIVV0, RsHV1, RsVH1, RIHV2, RIVH2, RIHH4, RIVV4, GIHh, GIhv, GIVh, GIVv
bytes/gate	20	56	32	72	88